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Applying an osteopathic intervention to improve mild to moderate mental health symptoms: a mixed-methods feasibility study protocol

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Abstract

Introduction: Mental health services are stretched in the UK and are in need of support. One approach that could improve mental health symptoms is osteopathy. Research suggests that osteopathy influences psychophysiological factors, which could lead to improvements in mental health. The first objective of this protocol is to investigate the feasibility and acceptability of four osteopathic interventions. A secondary aim is to evaluate the interventions’ effectiveness for improving psychophysiological and mental health outcomes.

Methods and analysis: This study will be an explanatory mixed-methods design (1). Participants will be 30 adults who have mild to moderate mental health symptoms and not experiencing any issues with pain. The feasibility and acceptability of the interventions will be the first primary outcome. Secondary outcomes will be physiological measures including heart rate variability (HRV), interoceptive accuracy (IAc) and blood pressure (BP). Psychological outcomes will also be measured by standardised questionnaires. These are being collected pre-and post-intervention. Additional outcomes will include recruitment rates and any adverse events that occur during the study. Participants will be randomised to one of four interventions. These are: (1) high-velocity and articulation techniques (HVAT), (2) soft-tissue massage (STM), (3) craniosacral therapy (CST), and (4) a combination of these three approaches. Participants will be interviewed about their experiences of the study and interventions. This will aid the assessment of the feasibility and acceptability of the study design.

Discussion: This study will assess the feasibility and acceptability of conducting osteopathic interventions for improving mental health outcomes. The results from this will help to inform the development of a future randomised controlled trial. The study will also produce original data which could provide preliminary evidence of whether osteopathic approaches are of benefit to individual’s mental health in the form of effect sizes, even if they are pain-free.
Keywords: osteopathy, psychophysiology, mental health, feasibility study, randomised trial.

Strengths and limitations

- This study will investigate the utility of osteopathic techniques for improving mental health, in the absence of any existing pain.
- The techniques being compared are based on previous literature and evidence.
- Due to this being a feasibility study, only a small number of participants are being recruited which will lead to low statistical power of the results.
- As the study is focused on comparing four interventions in a feasibility setting, there will be no control group comparison.

Administrative information

This feasibility study protocol has followed the Standard Protocol Items: Recommendations for Intervention Trials (SPIRIT) guidelines (Chan et al., 2013).

1. Title

Applying an osteopathic intervention to improve mild to moderate mental health symptoms: a mixed-methods feasibility study protocol.

2. Trial registration

ClinicalTrials.gov Identifier: NCT05674071

3. Protocol Version

November 2022, v1.

4. Funding

The Osteopathic Foundation, grant award number: URNLG010.

5.1 Author details

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Jerry Draper-Rodi, University College of Osteopathy and National Council for Osteopathic Research.
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Tel: 01582 488 455. Email: enquiries@osteopathy.org

5.3 Role of sponsor

The funders have no direct role in conducting this study. The funding is primarily being used to pay for the role of the research assistant on this project, held by JH-B.

Introduction

6.1 Background and rationale

In the UK, mental health problems such as anxiety and depression are an increasing burden within society. Recent estimates suggest that one in six people in the UK experience symptoms of depression or anxiety in any given week (2). For the individual, poor mental health can bring about problematic coping behaviours such as substance abuse and self-harm, leading to poor social relationships and in the worst cases; suicide (3). Mental health problems are commonly treated through psychotherapeutic means such as cognitive behavioural therapy, acceptance and commitment therapy, as well as relaxation techniques such as mindfulness practice and yoga (4). In addition, pharmacological solutions such as antidepressants and beta-blockers are used in treatment. These approaches have demonstrated effectiveness in many cases though they treat the symptoms and not the underlying causes (5,6).

With such a high demand being placed on the health services, such as these traditional forms of care, it can be difficult for many to receive treatment (7,8). It may therefore be important and helpful to consider innovative approaches that could support the demand for mental health services (9). Recently, it has been suggested that osteopathic interventions could be one such approach to support mental health services (10,11).
Osteopathy is an approach to health care that uses manual techniques to diagnose and treat patients (12). Osteopathy is an Allied Health Profession in England and osteopaths in the UK are regulated by statute (13). An osteopathic approach is patient-centred and focused on the patient’s health rather than disease-centred. The practices are evidence-informed and scientific rigour forms an important part of treating patients and managing cases (14). Osteopaths use manual contact to identify and evaluate movement in all structural and functional aspects of the patient, identifying alterations of function and movement that impede health and addressing these. Osteopaths use a variety of techniques to manipulate joints, muscle, and tissue. All of the techniques used have an effect on the interplay between the nervous and musculoskeletal systems. Specific techniques include myofascial release, lymphatic drainage, high-velocity, low amplitude (HVLA), articulatory techniques and muscle energy techniques.

Previous studies have examined how osteopathy may influence psychophysiological factors. A number of these have examined the influence of osteopathic manipulative therapy (OMT) on heart rate variability (HRV), which is considered a potentially important indicator of physical and psychological wellbeing (15,16). Cerritelli et al. (17) found that two sessions of OMT significantly increased HRV in healthy adults, relative to a sham control group. Similarly, Arienti et al. (18) found that applying a single session fourth ventricle compression (CV4) technique significantly increased HRV, compared to a placebo intervention.

6.2 Choice of comparators

This study will be comparing four osteopathic interventions: (1) articulation and high-velocity thrust (HVT) techniques, (2) soft-tissue massage, (3) craniosacral techniques, and (4) a combination of all three techniques.

The choice of techniques in this study has been informed by a systematic review and meta-analysis by the authors into the impact of osteopathic interventions on
psychophysiological factors. Articulation techniques were found to improve psychological outcomes (Castro-Sanchez et al., 2014; Espí-López et al., 2014), as well as autonomic nervous system indicators such as heart rate variability (HRV) and interoception (Cerritelli et al., 2020a). Similarly, interventions utilising HVT improved interoceptive accuracy and led to greater activation of brain areas associated with the interoceptive pathways (Cerritelli et al., 2020b). The studies that suggested articulation could improve psychological outcomes were conducted with patients with chronic pain and the study on HVT was with healthy participants. It will, therefore, be useful to understand whether articulation techniques and HVT could have positive psychological in the absence of pain and in the presence of mild mental health symptoms.

Next, soft-tissue massage techniques were chosen. Studies show that this approach has several positive psychological impacts for individuals with chronic pain (Baumgart et al., 2020) and pain-free patients who have mental health diagnoses (Rapaport et al., 2016; Sherman et al., 2010). Massage therapy has also been shown to have a preventative effect for general stress and wellbeing (Sharpe et al., 2007). Lastly, massage techniques have been shown to induce autonomic relaxation in healthy participants by increasing HRV (Seifert et al., 2018).

The third intervention will utilise craniosacral techniques. Three studies suggested that this approach induces autonomic relaxation by increasing HRV. One of these studies was conducted with patients with chronic pain (Castro-Sanchez et al., 2011) and two were carried out with healthy participants (Arienti et al., 2020; Edwards et al., 2018). It will therefore be useful to see whether any potential autonomic changes from craniosacral techniques translate

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1 This systematic review has been preregistered on OSF and the protocol is available via this link: https://osf.io/jrtpx/?view_only=63ff9a16b76c4b95b4233d3cd812f12d
to psychological benefits. It will also be useful to examine the potential utility of these techniques with participants who have mild mental health symptoms.

The body areas that each intervention will focus on have also been informed by the aforementioned literature. The interventions will operate on a standardised protocol whereby body areas will be worked on in order by the practitioner. The body areas focussed on and the order they will be worked on will be described further in the specific procedures of each intervention.

7. Objectives

This study aims to investigate the feasibility and acceptability of four osteopathic interventions for adults with mild to moderate symptoms of mental health. A secondary aim is to evaluate the influence of these four interventions on physiological factors and their effectiveness for improving psychological outcomes. It is first hypothesised that the interventions will be feasible and acceptable to participants. It is also hypothesised that the interventions will induce psychophysiological relaxation by significantly increasing HRV and improving interoceptive accuracy. A final hypothesis is that the four interventions will lead to improvements on measures of mental health.

8. Trial design

This study will utilise an explanatory sequential mixed-methods approach. In this approach the quantitative aspect forms the first part of the study, followed by a qualitative aspect to help provide further explanation and depth (1). For the quantitative aspect, the study will utilise a parallel, randomised design with a 1:1 allocation to each of the four conditions. The qualitative aspect will be completed by interviewing the participants of the intervention and the practitioner delivering them.

Methods: Participants, interventions and outcomes.

9. Study setting
The study will take place at Swansea University in South Wales, UK. Participants will be recruited from both the student population at the university and the general public. Recruitment at the university will be conducted by advertising in communal spaces with posters. Additionally, social media will be used for recruitment by reaching out to mental health support groups and sharing an advertisement for the study on various social networks. The interventions are only taking place in one location and country: Wales, UK. The study will begin on the 14th of December 2022.

10. Eligibility Criteria

Eligibility criteria will include being over 18 years of age, experiencing mild to moderate symptoms of depression, stress or anxiety and able to read, write and speak English. Prospective participants will be excluded if they are experiencing acute or chronic pain, and/or if they have more severe mental health issues. The rationale for excluding participants with pain is that it may present a confounding variable. That is, if the osteopathic intervention alleviates any pain the participants are experiencing, this may lead to improvements in psychological symptoms. It would therefore not be clear whether osteopathy has a more direct influence on mental health outcomes.

11.1 Interventions

Participants will receive one of four interventions based on osteopathic techniques. All four interventions will consist of a single session lasting approximately 30 minutes. The interventions as follows: (1) articulation and high-velocity thrust (HVT) techniques, (2) soft-tissue massage, (3) craniosacral techniques, and (4) a combination of all three techniques. A summary of the intervention protocols can be found in Table 1.

Table 1.
Summary of the four intervention protocols and procedures.

<p>| For all | 30-minute appointment |</p>
<table>
<thead>
<tr>
<th><strong>Articulation / HVT group</strong></th>
<th><strong>DURATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Observation + AROM (standing or sitting) + clinical examination for SD (sitting, prone or supine)</td>
<td>1. 10 min</td>
</tr>
<tr>
<td>2. Techniques:</td>
<td>2. 20 min</td>
</tr>
<tr>
<td>a. SD found: HVT to the area, unless contraindicated (info on BP/HA)</td>
<td></td>
</tr>
<tr>
<td>b. No SD found:</td>
<td></td>
</tr>
<tr>
<td>i. HVT TSp and ribs</td>
<td></td>
</tr>
<tr>
<td>ii. Articulation hips in extension</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Soft tissue group</strong></th>
<th><strong>DURATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Full body, slow and superficial</td>
<td></td>
</tr>
<tr>
<td>1. Prone:</td>
<td>1. 15 min</td>
</tr>
<tr>
<td>a. upper / mid / lower back</td>
<td></td>
</tr>
<tr>
<td>b. upper buttocks</td>
<td></td>
</tr>
<tr>
<td>c. hamstrings</td>
<td></td>
</tr>
<tr>
<td>d. calves</td>
<td></td>
</tr>
<tr>
<td>2. Supine:</td>
<td>2. 15 min</td>
</tr>
<tr>
<td>a. Neck incl. suboccipital muscles</td>
<td></td>
</tr>
<tr>
<td>b. Shoulders</td>
<td></td>
</tr>
<tr>
<td>c. Pectoral muscles</td>
<td></td>
</tr>
<tr>
<td>d. Arms</td>
<td></td>
</tr>
<tr>
<td>e. Quadriceps</td>
<td></td>
</tr>
<tr>
<td>f. Feet</td>
<td></td>
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<table>
<thead>
<tr>
<th><strong>Cranial group</strong></th>
<th><strong>DURATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Looking for stiffness, asymmetry and tenderness on:</td>
<td></td>
</tr>
<tr>
<td>1. Sacrum</td>
<td>1. 10 min</td>
</tr>
<tr>
<td>2. Head</td>
<td>2. 10 min</td>
</tr>
<tr>
<td>Dysfunction found: myofascial release technique (10min/area); if no dysfunction found: functional techniques applied to each area (10min/area)</td>
<td></td>
</tr>
<tr>
<td>3. CV4</td>
<td>3. 10 min</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Combined group</strong></th>
<th><strong>DURATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Observation + AROM + clinical exam for SD</td>
<td>1. 9 min</td>
</tr>
<tr>
<td>2. HVT TSp</td>
<td>2. 7 min</td>
</tr>
<tr>
<td>3. Soft tissue upper and lower back prone</td>
<td>3. 7 min</td>
</tr>
<tr>
<td>4. CV4 and suboccipital release</td>
<td>4. 7 min</td>
</tr>
</tbody>
</table>

**Abbreviations:** AROM: active range of movement; BP: blood pressure; CV4: Compression of the Fourth Ventricle technique; HA: headache; HVT: high velocity thrust techniques; SD: somatic dysfunction; TSp: thoracic spine

### 11.1.1 Articulation and high-velocity techniques

The articulation and high-velocity (AHVT) intervention will begin with an examination of the participant to search for somatic dysfunction (19). The AHVT
intervention will primarily be targeting all areas of the participant’s spine. That is, the cervical, thoracic and lumbar areas, and also the sacroiliac joints. The practitioner will first observe the participant while standing, then will observe active range of movements in with the participant in standing and/or sitting positions. Then the practitioner will continue their examination searching first by light and then deeper palpation for signs associated with somatic dysfunction with the participant sitting down or lying prone or supine. This segment of the intervention will be allocated approximately 10 minutes.

If areas of the spine are found to have somatic dysfunction, then AHVT techniques will be applied to these areas. If no areas of somatic dysfunction are identified in the aforementioned spinal areas, then the practitioner will first focus on applying AHVT techniques to the thoracic spine and rib cage areas, followed by articulation techniques such as hip extension. The applying of techniques will be allocated approximately 20 minutes.

11.1.2 Soft-tissue massage techniques

The soft-tissue massage (STM) intervention will be a full-body massage. The participant will first be in the prone position and the practitioner will massage the upper, middle and lower areas of the back, the upper buttocks, then the hamstrings and calves. This will be approximately 15 minutes. The participant will then move into the supine position where they will receive massage on their neck, shoulders, pectoral muscles, arms, quadriceps and feet. This will also be allocated approximately 15 minutes. The literature suggests that slower techniques such as Swedish massage demonstrate effectiveness (20,21). There is also evidence that focussing on the upper layers of the skin has psychological benefits (22). These techniques will therefore be employed here.

11.1.3 Craniosacral techniques

This intervention will utilise craniosacral techniques (CST). This approach targets the cranial muscles and muscles around the central nervous system (23). The CST intervention will
begin with an examination for somatic dysfunction such as stiffness, asymmetry or
tenderness. The body areas focussed on will be the head and sacrum which are body areas
commonly associated with CST. If areas of dysfunction are identified, then the practitioner
will perform myofascial release. If no areas of dysfunction in these areas are identified, the
practitioner will first focus on the sacral region and then move on to other areas associated
with CST. For sacral and cranial areas, approximately 10 minutes will be allocated each for
20 minutes total. The intervention will conclude with fourth ventricle compression (CV4).
This technique is performed on the occipital bone. CV4 will be allocated approximately 10
minutes of the intervention.

11.1.4 Combination of techniques

This intervention will be a combination of all three techniques used in the other interventions
(COMBO). The intervention will begin with an examination of the participant and checking
active and passive range of movement. This examination will be allocated approximately 9
minutes. Using a combination of treatments the intervention will consist of: (1) high velocity
techniques applied to the thoracic spine (approximately 7 minutes), (2) soft-tissue massage to
the upper and lower back of the participant in prone (approximately 7 minutes), (3) CV4 and
suboccipital muscles release (approximately 7 minutes). This intervention will therefore last
approximately 30 minutes.

11.2 Modifications

In the interest of participant’s safety, certain modifications may be made to the interventions
if participants have body areas which are tender or if they present undiagnosed HBP. This is
mostly relevant to the AVHT intervention and COMBO intervention which will have
techniques that are of higher force. If a participant in the AVHT or COMBO interventions
presents with HBP, neck pain or headaches during the intervention then the practitioner will
not work on the cervical spine area and focus on the other spinal regions in the protocol.
11.3 Adherence

As the intervention only consists of one session, adherence is not necessarily applicable. Instead, a record will be kept of any participants who asked to end the intervention session early.

11.4 Concomitant care

Participants will be asked at pre-intervention if they are receiving any drug treatment for mental health (e.g., antidepressants), or psychotherapy (e.g., cognitive behavioural therapy). Participants will not be excluded on this basis, but these will be factored into the main statistical analysis as covariates.

12. Outcomes

12.1 Feasibility

The feasibility of the recruitment process will be determined by the number of people who respond to the advertisements and the number of people who are eligible/ineligible following the screening process. The feasibility of the measurement tools will first include whether participants have enough time to complete all measures. Feasibility of the questionnaires will also be assessed by any missing data. Additionally, the feasibility of the physiological measurements will be informed by the time taken to set up the equipment.

12.2 Acceptability

The acceptability of the study will be largely informed by the qualitative interview following the intervention. Participants will be asked about their experience of taking part, including what they preferred or did not prefer about the intervention and whether it has been useful to them. The practitioner will also be asked about their experience of delivering the interventions and for their feedback. Additionally, any adverse events occurring during the study will be logged using the Adverse Events Report Form (AERF; this can be found in Supplemental material 1.)
12.3 Psychological outcomes

These measures are intended to provide some initial data on the potential utility of the intervention for outcomes such as depression, anxiety and stress, psychological flexibility, and interoceptive awareness. They will be collected at pre- and post-intervention.

12.3.1 Depression, Anxiety and Stress Scale (DASS-21)

The DASS (24) is a self-report measure made up of 21 items with three subscales that measure depression, anxiety and stress. The DASS will also be used a screening tool to identify eligible participants in terms of the severity of mental health symptoms. Examples of items include “I couldn’t seem to experience any positive feeling at all” for the depression scale, “I felt I was close to panic” for the anxiety scale, and “I found myself getting agitated” for the stress scale. These are then rated on a four-point Likert scale ranging from 0 (never) to 3 (almost always). Higher scores indicate higher levels of depression, anxiety and stress. The subscales have good internal reliability as measured by Cronbach’s alpha coefficients (α), which are 0.88 for depression, 0.82 for anxiety and 0.90 for stress, as well as 0.93 the total score (25).

12.3.2 International Positive and Negative Affect Schedule- Short-Form (PANAS-SF)

The PANAS-SF (26) is a short-form version of the PANAS and uses 10 items to measure two subscales of positive and negative affect (PA and NA). Participants are asked to what extent they have felt certain states or emotions, such as “inspired” for the PA scale and “upset” for the NA scale. These are then rated on a five-point Likert scale ranging from 1 (very slightly or not at all) to 5 (extremely). Higher scores indicate higher levels of PA and NA. Both the PA and NA subscales have good internal reliability with both having a Cronbach’s α of 0.84 (26).

12.3.3 Acceptance and Action Questionnaire-II (AAQ-II)
The AAQ-II (27) is a self-report measure made up of 7 items that measures psychological inflexibility or as it also referred to, experiential avoidance. Items include a list of statements such as “I’m afraid of my feelings” and “worries get in the way of my success”. These items are then rated on a seven-point Likert scale from 1 (never true) to 7 (always true). Scores are then totalled with higher scores indicating greater levels of psychological inflexibility and experiential avoidance. The AAQ-II has good internal reliability with a Cronbach’s $\alpha$ of 0.84 (27).

12.3.4 Self as Context Scale (SACS)

The SACS (28) uses 10 items to measure self-as-context, one of the acceptance components of psychological flexibility. Self-as-context can be described as a transcendent sense of self, where the individual is able to distance their “noticing self” from internal thoughts and feelings. The SACS has two subscales, (1) centering e.g., “when I am upset, I am able to find a place of calm within myself”, and (2) transcending e.g., “As I look back upon my life so far, I have a sense that part of me has been there for all of it”. Items are then rated on a seven-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). Higher scores on the subscales indicate higher levels of centering, transcending and a higher total score indicates greater levels of self-as-context. The SACS has good internal reliability with Cronbach’s $\alpha$ of 0.81 for centering, 0.78 for transcending and 0.81 for overall SACS score (28).

12.3.5 Multidimensional Assessment of Interoceptive Awareness Version 2 (MAIA-2)

The MAIA-2 (29) is a 37-item self-report measure of interoceptive awareness. The MAIA-2 uses eight subscales which are: (1) noticing e.g., “when I am tense, I notice where the tension is located in my body”, (2) not-distracting e.g., “I distract myself from sensations of discomfort”, (3) not-worrying e.g., “when I feel physical pain, I become upset”, (4) attention regulation (e.g., “I can pay attention to my breath without being distracted by things happening around me”), (5) emotional awareness e.g., “I notice how my body changes when
I am angry”, (6) self-regulation e.g., “when I feel overwhelmed I can find a calm place inside”, (7) body listening e.g., “I listen for information from my body about my emotional state, and (8) trusting e.g., “I trust my body sensations”. The items are rated on a six-point Likert scale ranging from 0 (never) to 5 (always). The scales have good internal reliability with the Cronbach’s alpha coefficients for the scales being: 0.64 for noticing, 0.74 for not-distracting, 0.67 for not-worrying, 0.83 for attention regulation, 0.79 for emotional awareness, 0.79 for self-regulation, 0.80 for body listening, and 0.83 for trust (29).

12.4 Physiological outcomes

12.4.1 Heart rate variability (HRV)

HRV will be measured using a medical-grade Holter electrocardiogram (ECG) monitor. Measurements will be taken at two timepoints, pre- and post-intervention. A time-domain signal measure will be calculated using root mean square of successive interval differences (RMSSD). Frequency-domain measurements will be calculated by using low frequency power, high frequency power and low frequency to high frequency ratio (LF/HF).

12.4.2 Interoceptive accuracy (IAc)

Participants will perform a heartbeat detection task as measure of IAc. This is conducted in the form of the heartbeat perception task which is performed according to the Mental Tracking Method (30) using intervals of 30, 35, 40, and 45s that are separated by 30s resting periods. During each trial R–R intervals are recorded, and participants are asked to silently count their heartbeats without the use of an exteroceptive aid (such as taking one’s pulse). At the end of each period participants verbally report the number of counted heartbeats. The participants are not informed about the length of the counting phases nor about the quality of their performance. Interoceptive sensibility will also be measured through participant’s subjective assessments about how accurately they perceived heartbeats (31). These measures will be completed pre- and post-intervention.
12.4.3 Blood pressure (BP)

BP will be measured at pre- and post-intervention. This will be carried out in line with the National Institute for Health and Care Excellence (NICE) recommendations. That is, BP will be collected in a room which is quiet, relaxed, and temperate, whilst the participant will be quiet and seated, and their arm outstretched and supported, using an appropriate cuff size for the person’s arm (32). This outstretching of the arm will allow the practitioner to assess any undiagnosed high blood-pressure (HBP). If the participant has HBP it can make some of the osteopathic techniques less safe, so it is important to establish this. HBP will be determined according to the NICE recommendation of BP results that are 140/90 mmHg and over (32). In addition to participant safety, measuring BP will provide data of any impact the intervention might have on this physiological indicator.

12.5 Additional outcomes

Demographic information will also be collected from participants relating to their gender, age and ethnic background. Although participants will have been screened for chronic pain, they will be asked whether they are currently or have recently been experiencing any neck pain or headaches. This is to inform the clinician about any problematic body areas, which may therefore be avoided in the intervention. The participants should be presenting as pain-free due to the initial screening process, but this is still a necessary safety measure. Participants will not be excluded if they present neck pain or headaches. However, if a number of participants indicate they are experiencing neck pain or headaches, this may be explored in the analysis as a covariate.

Participants will also be asked about whether they are currently receiving any mental health treatment. They will be asked whether they are currently taking any antidepressants or other related prescribed medication for mental health issues. Participants will also be asked whether they have recently attended or are currently attending any form of talking therapy or
other psychotherapy. Participant’s prescription medication or psychotherapy status will not exclude them from the study. However, this will again be entered as a covariate if a number of participants report that they are receiving these psychological treatments.

Lastly will be the noting of any adverse events that occur during the intervention or study period. These will be filled out by the practitioner using the AERF and collected by the researcher if occurring during the intervention. If participants contact the researcher after the intervention regarding an adverse event, then this will be logged by the researcher.

12.6 Qualitative outcomes

Participants will be interviewed about their experience of the intervention via telephone approximately one week after they have completed the study. The interviews will be semi-structured and follow a pre-defined schedule (see Table 2). The interview will be centred around the acceptability of the intervention, but also aspects of the study. To this end the interview will ask questions about motivations for taking part and expectations, how informed they felt before taking part, their experience of completing the questionnaires and having physiological measures taken, and their experience of the intervention itself. Some questions will also ask about participants how they have felt since the intervention.

Participants will then be given a chance to provide any other feedback or thoughts on taking part in the study. The audio from the interviews will be recorded and then transcribed.

Analysis of the data will be conducted using reflexive thematic analysis (Braun & Clarke, 2021). This involves initially familiarising oneself with the transcripts and then coding the data. Codes are then collated into themes. From here, themes are refined and categorised into main themes, midlevel themes and subthemes. Themes will then be discussed in terms of their strength. That is an indication will be provided of whether themes were common across many participants’ accounts, or only mentioned by a few. It is hoped that by employing
qualitative methods, a richer account of the acceptability of the study and intervention to participants can be obtained.

The practitioner will also be interviewed about their experience of delivering the intervention. This interview will also be thematically analysed, and the resulting themes explored.

**Table 2.** Interview schedule for qualitative interviews.

<table>
<thead>
<tr>
<th>Information and consent</th>
<th>1. Were there any parts of the information sheet that were difficult to understand?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Did any part of your participation feel unexpected, based on what you were told in the information sheet?</td>
</tr>
<tr>
<td>Motivations for participating</td>
<td>3. What motivated you to participate in the study?</td>
</tr>
<tr>
<td></td>
<td>4. What did you know about osteopathy before taking part?</td>
</tr>
<tr>
<td>Outcome measures-questionnaires</td>
<td>5. Were there any questions or words on the questionnaires that were difficult to understand?</td>
</tr>
<tr>
<td></td>
<td>6. What was your experience like filling out the questionnaires?</td>
</tr>
<tr>
<td>Outcome measures-physiological</td>
<td>7. What was your experience of having an ECG and blood pressure taken?</td>
</tr>
<tr>
<td></td>
<td>8. What was your experience of doing a heartbeat detection task?</td>
</tr>
<tr>
<td>Intervention</td>
<td>9. Did you feel that the practitioner adequately explained procedures to you?</td>
</tr>
<tr>
<td></td>
<td>10. What could have gone better during the session?</td>
</tr>
<tr>
<td></td>
<td>11. Did you take anything useful away from the session or learn anything new?</td>
</tr>
<tr>
<td></td>
<td>12. How likely are you to visit an osteopath again or seek similar treatments after this?</td>
</tr>
<tr>
<td>Closing points</td>
<td>13. What else could you tell us about your experience of taking part in this study?</td>
</tr>
</tbody>
</table>

13. Participant timeline

See Table 3 for the participant timeline.
Table 3.  
Participant timeline

<table>
<thead>
<tr>
<th>Activity/Assessment</th>
<th>T1</th>
<th>T0</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
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<td>Approx. time to complete</td>
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<td></td>
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</tr>
<tr>
<td>Pre-intervention</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-intervention tests</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follow-up 1-week</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Informed consent                    | 5 mins |       | X      |        |        |        |
| Screening with DASS                 | 5 mins |       | X      |        |        |        |
| Randomisation                       | 15 mins|       |        |        |        |        |
| Baseline assessment-questionnaires  | 15 mins|       | X      |        |        |        |
| Baseline assessment-physiological   | 15 mins|       | X      |        |        |        |
| Intervention                        | 30 mins|       |        |        |        | X      |
| Post-intervention questionnaires    | 15 mins|       |        |        |        | X      |
| Post-intervention physiological     | 15 mins|       |        |        |        | X      |
| Telephone interview                 | 30 mins|       |        |        |        | X      |

Abbreviations: T: Timepoint; F: Follow-up; DASS: Depression Anxiety Stress Scale.

14. Sample Size

The study will aim to recruit 30 participants. This number of participants is generally deemed sufficient for feasibility studies (33). In terms of practical constraints, it also represents the maximum number that can be accommodated with the resources available.

15. Recruitment

Participants will contact the research team if they are interested in taking part. They will then be given an information sheet to read and consent form to sign. Following this they will complete the Depression, Anxiety, Stress Scale (DASS) to complete to determine their eligibility regarding mental health symptoms. If eligible they will be invited to take part in the intervention. If they display severe mental health symptoms, they will not be invited to take part further and signposted to the relevant mental health services and charities.

Methods: Assignment of interventions
16. Allocation

16.1 Sequence generation

Participants will be randomly assigned to one of the four conditions using a computerised random number generator. Permuted block randomisation will be used to ensure that equal numbers of participants are in each condition. The block sizes will not be disclosed to help ensure concealment and prevent any potential prediction of group allocation. This will be conducted by the PI of the study DJE, whilst the researcher (outcome assessor) JH-B is blinded to this randomisation process.

16.2 Concealment mechanism

Allocation concealment will be ensured using sequentially numbered, sealed opaque envelopes which contain the group assignment. The PI of the study DJE, will carry out the allocation concealment, and ensure that the researcher (outcome assessor) JH-B is blinded to the intervention allocation.

16.3 Implementation

All participants who provide informed consent and who meet the eligibility criteria will be randomised into a study condition (as described in section 16.1). The randomisation DJE will not be directly involved in the recruitment or data collection, and instead the researcher JHB (outcome assessor) will conduct the recruitment. The list of random numbers that correspond to group allocation will not be revealed to outcome assessor JHB involved in data collection or recruitment. The sealed envelopes will contain a randomisation number and corresponding intervention identity code for the allocation of participants into intervention group. The osteopathic practitioner will then be able to open the envelope and determine which intervention is to be delivered on the day the study is conducted.

17.1 Blinding (masking)
The outcome assessor JHB will be blind to participants’ group allocation. After pre-intervention psychometric and psychophysiological measures (see section 12.3 and 12.4 respectively) have been completed, the outcome assessor will leave the room (to ensure blinding) and the intervention will begin, conducted by the osteopath. Participants will not be blinded to study intervention, as the osteopathic practitioner will need to explain study and intervention procedures, in line with the osteopathic practice standards (14) and ethical consent. The practitioner will not be blinded to the intervention type (as they need to know what intervention to deliver) but will be blinded to the study outcomes. The outcome assessor will also be conducting the data analysis, and the random numbers corresponding to each group will only be revealed when this analysis has been completed. To ensure participants do not disclose the condition they were allocated to, they will be asked not to communicate directly to the outcome assessor about the intervention they received. The study will therefore be single-blinded, where the outcome assessor is blind to intervention allocation, and the osteopathic practitioner will not be blind (hence single-blind).

17.2 Emergency unblinding

As the practitioner is not blinded, no emergency unblinding procedures are deemed necessary.

Methods: Data management and analysis

18. Data management

All data will be entered electronically at the university where the data is being collected and kept in a password-protected folder, where only the outcome assessor (JHB) will have access to for the duration of the study. The electronic data will be kept confidential, and participant’s names will not be linked to their dataset. For the longer term, electronic datasets will be kept indefinitely in the interest of transparency to fulfil any requests for the original data and maintained on the Open Science Framework (OSF).
19. Statistical Methods

19.1 Outcomes

Statistical analysis will be conducted using SPSS (IBM, 2022). Mean and standard deviation will be reported for demographic data that includes gender, age, and ethnicity. For the main analysis, data will first be examined for normality using the Shapiro-Wilk test. If data is skewed, logarithmic transformation will be used, otherwise analysis will continue without any transformation. HRV data will be pre-processed, inspected for any potential artifacts, where these will be removed if identified. RMSSD will be calculated on the pre-processed artifact removed data using Kubios version 3.5\(^2\) via Matlab version R2021a. Interoceptive accuracy (IAc) will then be calculated using the formula: \(\text{IAc} = \frac{1}{4} \sum (1 - (\text{recorded heartbeats} - \text{counted heartbeats})/\text{recorded heartbeats})\). The psychometrics will be totalled according to the relevant questionnaire instructions and subscales.

The main analysis will comprise of seven separate mixed design two (pre- and post-intervention) by four (AVHT, STM, CST, combination\(^3\)) analysis of covariance (ANCOVA) models. This will comprise of five separate ANCOVAs for the five psychometrics (DASS, PANAS-SF, AAQ, SACS, MAIA) and another two ANCOVAs for the physiological measures of IAc and HRV (as measured by RMSSD and LF/HF ratio). Covariates will consist of: (1) whether participants are currently receiving psychotherapy (yes or no) and (2) whether participants are receiving pharmacological treatment (yes or no). Significant models will be examined further using post hoc Bonferroni tests.

19.2 Additional Analyses

\(^2\) https://www.kubios.com/
\(^3\) Please see: Interventions section 11.1 for full details of these interventions.
Exploratory correlational analyses will also be conducted to examine relationships between changes from pre- to post-intervention on the various measures (e.g., relationship between change from pre-post HRV RMSSD and pre-post DASS scores).

19.3 Analysis population and missing data

The study will operate on an intention-to-treat basis. All participants randomised and with pre-intervention data will be included in the final analysis. Any participants with missing data will be included in the analysis using the multiple imputation feature of SPSS.

Methods: Monitoring

20. Data monitoring

As this study is taking place over a short duration as a feasibility study and not a full RCT, no formal committee for data monitoring is required.

21. Harms

The osteopathic practitioner will inform the participants about the general potential common adverse effects of osteopathy namely some stiffness and soreness in the days following the intervention, and rare adverse events including tissue damage, in line with informed consent processes. The osteopathic practitioner will record any adverse effects one the day the intervention is received (that occur during or immediately after the intervention) in the Adverse Events report form (see supplemental material 1). Participants will also be advised to contact the PI DJE if they have any concerns or adverse events following the intervention in subsequent days after the intervention was received. If such events are reported, these will again be reported by DJE in the Adverse Events report. Any adverse events or harms that are ranked highly on severity will be reported to the ethical committee.

22. Auditing
As the study is taking place over a short duration and only at one site, no formal auditing processes are deemed necessary, though PI will have regular team meetings to ensure the study is following the research protocol at all times.

Methods: Patient and public involvement statement

Key stakeholders were consulted and involved at a very early stage of the research process. The Patient Experience and Evaluation in Research (Patient Experience and Evaluation in Research (PEER): https://www.swansea.ac.uk/humanandhealthsciences/research-at-the-college-of-human-and-health/patientexperienceandevaluationinresearchpeergroup/) group in the College of Human and Health Sciences at Swansea University were consulted. This group represented members of the public, students, and staff members, several of whom reported that they had experienced depression, anxiety or stress at some point in their lives and emphasised the need for innovative approaches of the delivery of mental health support. The feasibility design was explained to them, and they gave positive feedback about the nature of the preliminary research plan.

Ethics and dissemination

23. Research ethics approval

The protocol for this feasibility study has received ethical approval from the Department of Psychology Ethics Committee at Swansea University, ethical review reference number: 2022-5603-4810.

24. Protocol amendments

Any deviations from the protocol that could impact the conduct or bias of the study will be clearly outlined and justified in the final written report. Version control of the protocol using identifiers and dates, along with a list of amendments will be clearly listed. This will enable tracking of the history of amendments and identification of the most recent protocol version.

25. Consent
Participants will scan a QR code on recruitment posters or click a link via email/social media adverts that will take them to the study’s information sheet. The information sheet emphasises that participation is voluntary and that they can withdraw from the study at any stage, without needing to provide a reason. If they have any questions or concerns at this stage, they are encouraged on the information sheet to contact the research team. If they are willing to proceed, they will complete an online consent form (see Supplemental material 2).

26. Ancillary research

The data collected in this study will not be used for any other ancillary research.

27. Confidentiality

Participants will be assigned a coded ID number to maintain confidentiality. Any records of personal identifiers such as informed consent forms will be stored separately to data with ID numbers. To limit data access to the minimum number of individuals, only the researcher JHB will have access to the data for analysis.

28. Declaration of interests

This projected is being funded by the Osteopathic Foundation (OF). The OF has no direct input into the study. The individual authors have no direct conflicts of interest to declare.

29. Access to data

Only the researcher JHB will have access to the dataset during the study period. Upon completion, the collected data will be deidentified and made available on the Open Science Framework (OSF). Similarly, the SPSS statistical syntax code used will be made available on OSF.

30. Ancillary and post-trial care

Participants will be fully debriefed once they have completed the study. The contact details of the research team will be provided should participants have any concerns. As the participants will be presenting with mild to moderate mental health symptoms, the debrief form will
encourage participants to seek support services such as mental health charities or their GP if their psychological condition deteriorates at any time.

31. Dissemination policy

31.1 Trial results

Following the completion of the study, it is anticipated to take around 2-3 months to compile the final results ready for publication to an appropriate peer-reviewed journal. The study’s results may also be used as part of presentations at any relevant conferences.

31.2 Authorship

The authors of this protocol will also be the authors on the final report. All authors have made substantive contributions to the design of the study. Additionally, all authors will have made substantive contributions to the interpretation of the data collected and the writing of the final report.

31.3 Reproducible research

This protocol will be available to researchers via open access publication. The dataset collected will be deidentified and made available on OSF. Similarly, the statistical syntax code used will be made available on OSF. These will be made available no later than 1 year upon completion of data collection.

Acknowledgements

We would like to thank Stephen Hartshorn for his contribution in delivering the osteopathic interventions.

Contributorship statement

JHB wrote the first draft, then all authors subsequently revised additional drafts. All authors have made substantive contributions to the concept, design and writing of this study.

Competing interests
There are no competing interests. This project is funded by the Osteopathic Foundation (OF). The OF has no direct input into any aspects of this study. The individual authors have no direct conflicts of interest to declare.

Funding

This research has been funded by The Osteopathic Foundation, grant award number: URNLG010.

References


32. NICE. Hypertension in adults: diagnosis and management. London; 2022.

Supplemental material 1.
Adverse events report form

<table>
<thead>
<tr>
<th>Adverse Events Report Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practitioner ID:</td>
</tr>
<tr>
<td>Date:</td>
</tr>
<tr>
<td><strong>Description of adverse event:</strong></td>
</tr>
<tr>
<td><strong>Actions taken:</strong></td>
</tr>
<tr>
<td>What?</td>
</tr>
<tr>
<td>By whom?</td>
</tr>
<tr>
<td><strong>Further actions needed?</strong></td>
</tr>
<tr>
<td>Section/item</td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
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</tr>
<tr>
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</tr>
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<td>Trial registration</td>
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</tr>
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<tr>
<td>Roles and responsibilities</td>
</tr>
<tr>
<td></td>
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</tr>
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</table>
5d Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)

Introduction

Background and rationale
6a Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention
Pages 4-5, Section 6.1

6b Explanation for choice of comparators
Pages 5-7, Section 6.2

Objectives
7 Specific objectives or hypotheses
Page 7, Section 7

Trial design
8 Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory)
Page 7, Section 8

Methods: Participants, interventions, and outcomes

Study setting
9 Description of study settings (eg, community clinic, academic hospital) and list of countries where data will be collected. Reference to where list of study sites can be obtained
Pages 7-8, Section 9

Eligibility criteria
10 Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists)
Page 8, Section 10

Interventions
11a Interventions for each group with sufficient detail to allow replication, including how and when they will be administered
Pages 8-11, Section 11.1

11b Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease)
Page 11, Section 11.2

11c Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests)
Page 11-12, Section 11.3
11d Relevant concomitant care and interventions that are permitted or prohibited during the trial

Outcomes

Primary, secondary, and other outcomes, including the specific measurement variable (e.g., systolic blood pressure), analysis metric (e.g., change from baseline, final value, time to event), method of aggregation (e.g., median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended

Participant timeline

Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure)

Sample size

Estimated number of participants needed to achieve study objectives and how it was determined, including clinical and statistical assumptions supporting any sample size calculations

Recruitment

Strategies for achieving adequate participant enrolment to reach target sample size

Methods: Assignment of interventions (for controlled trials)

Allocation:

16a Method of generating the allocation sequence (e.g., computer-generated random numbers), and list of any factors for stratification. To reduce predictability of a random sequence, details of any planned restriction (e.g., blocking) should be provided in a separate document that is unavailable to those who enrol participants or assign interventions

16b Mechanism of implementing the allocation sequence (e.g., central telephone; sequentially numbered, opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned

16c Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions

17a Who will be blinded after assignment to interventions (e.g., trial participants, care providers, outcome assessors, data analysts), and how
Methods: Data collection, management, and analysis

Data collection methods 18a Plans for assessment and collection of outcome, baseline, and other trial data, including any related processes to promote data quality (eg, duplicate measurements, training of assessors) and a description of study instruments (eg, questionnaires, laboratory tests) along with their reliability and validity, if known. Reference to where data collection forms can be found, if not in the protocol

18b Plans to promote participant retention and complete follow-up, including list of any outcome data to be collected for participants who discontinue or deviate from intervention protocols

Data management 19 Plans for data entry, coding, security, and storage, including any related processes to promote data quality (eg, double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol

Statistical methods 20a Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol

20b Methods for any additional analyses (eg, subgroup and adjusted analyses)

20c Definition of analysis population relating to protocol non-adherence (eg, as randomised analysis), and any statistical methods to handle missing data (eg, multiple imputation)

Methods: Monitoring

Data monitoring 21a Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed

21b Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial
Harms 22 Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct

Auditing 23 Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor

Ethics and dissemination

Research ethics 24 Plans for seeking research ethics committee/institutional review board (REC/IRB) approval

Protocol amendments 25 Plans for communicating important protocol modifications (eg, changes to eligibility criteria, outcomes, analyses) to relevant parties (eg, investigators, REC/IRBs, trial participants, trial registries, journals, regulators)

Consent or assent 26a Who will obtain informed consent or assent from potential trial participants or authorized surrogates, and how (see Item 32)

Consent or assent 26b Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable

Confidentiality 27 How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial

Declaration of interests 28 Financial and other competing interests for principal investigators for the overall trial and each study site

Access to data 29 Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators

Ancillary and post-trial care 30 Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation

Dissemination policy 31a Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions
31b Authorship eligibility guidelines and any intended use of professional writers

31c Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code

**Appendices**

<table>
<thead>
<tr>
<th>32</th>
<th>Model consent form and other related documentation given to participants and authorized surrogates</th>
<th>Supplemental material 2</th>
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<td>33</td>
<td>Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable</td>
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</tr>
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</table>

*It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons "Attribution-NonCommercial-NoDerivs 3.0 Unported" license.*
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Applying an osteopathic intervention to improve mild to moderate mental health symptoms: a mixed-methods feasibility study protocol

Josh Hope-Bell¹, Jerry Draper-Rodi²,³ & Darren J. Edwards¹

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²National Council for Osteopathic Research, University College of Osteopathy, UK
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Abstract

Introduction: Mental health services are stretched in the UK and are in need of support. One approach that could improve mental health symptoms is osteopathy. Research suggests that osteopathy influences psychophysiological factors, which could lead to improvements in mental health. The first objective of this protocol is to investigate the feasibility and acceptability of four osteopathic interventions. A secondary aim is to evaluate the interventions’ effectiveness for improving psychophysiological and mental health outcomes.

Methods and analysis: This study will be an explanatory mixed-methods design (1). Participants will be 30 adults who have mild to moderate mental health symptoms and not experiencing any issues with pain. The feasibility and acceptability of the interventions will be the primary outcomes. Secondary outcomes will be physiological measures including heart rate variability (HRV), interoceptive accuracy (IAc), and blood pressure (BP). Psychological outcomes, collected pre-and post-intervention, will also be measured by five standardised questionnaires, which include: (1) the Depression, Anxiety and Stress Scale; (2) the International Positive and Negative Affect Schedule- Short-Form; (3) Acceptance and Action Questionnaire-II ; (4) the Self as Context Scale; (5) and the Multidimensional Assessment of Interoceptive Awareness Version 2. Participants will be randomised to one of four intervention groups and receive a single intervention treatment session. These intervention groups are: (1) high-velocity and articulation techniques (HVAT), (2) soft-tissue massage (STM), (3) craniosacral therapy (CST), and (4) a combination of these three approaches. Mixed design two (pre- and post-intervention) by the four interventions analysis of covariance (ANCOVA) models will be used to analyse the quantitative data for each quantitative measure. Participants will also be interviewed about their experiences of the study and interventions and a thematic analysis will be used to analyse this qualitative data. This will aid the assessment of the feasibility and acceptability of the study design.
Discussion: This study will assess the feasibility and acceptability of conducting osteopathic interventions for improving mental health outcomes. The results from this will help to inform the development of a future randomised controlled trial. The study will also produce original data which could provide preliminary evidence of whether osteopathic approaches are of benefit to individual’s mental health in the form of effect sizes, even if they are pain-free.

Trial registration: ClinicalTrials.gov Identifier: NCT05674071

Keywords: osteopathy, psychophysiology, mental health, feasibility study, randomised trial.

Strengths and limitations
- This study will investigate the utility of osteopathic techniques for improving mental health, in the absence of any existing pain
- The techniques being compared are based on previous literature and evidence
- Due to this being a feasibility study, only a small number of participants are being recruited which will lead to low statistical power of the results
- As the study is focused on comparing four interventions in a feasibility setting, there will be no control group comparison

Administrative information
This feasibility study protocol has followed the Standard Protocol Items: Recommendations for Intervention Trials (SPIRIT) guidelines (see Supplemental material 1) (1).

1. Title
Applying an osteopathic intervention to improve mild to moderate mental health symptoms: a mixed-methods feasibility study protocol.

2. Trial registration
ClinicalTrials.gov Identifier: NCT05674071

3. Protocol Version
November 2022, v1.
4. Funding

The Osteopathic Foundation, grant award number: UR5NLG010.

5.1 Author details

Josh Hope-Bell & Darren J. Edwards, Department of Public Health, Swansea University.

Jerry Draper-Rodi, University College of Osteopathy and National Council for Osteopathic Research.

5.2 Name and contact information for the trial sponsor

The Osteopathic Foundation, 3 Park Terrace, Manor Road, Luton, Bedfordshire, LU1 3HN.

Tel: 01582 488 455. Email: enquiries@iosteopathy.org

5.3 Role of sponsor

The funders have no direct role in conducting this study. The funding is primarily being used to pay for the role of the research assistant on this project, held by JH-B.

Introduction

6.1 Background and rationale

In the UK, mental health problems such as anxiety and depression are an increasing burden within society. Recent estimates suggest that one in six people in the UK experience symptoms of depression or anxiety in any given week (2). For the individual, poor mental health can bring about problematic coping behaviours such as substance abuse and self-harm, leading to poor social relationships and in the worst cases; suicide (3). Mental health problems are commonly treated through psychotherapeutic means such as cognitive behavioural therapy, acceptance and commitment therapy (ACT), as well as relaxation techniques such as mindfulness practice and yoga (4). In addition, pharmacological solutions such as antidepressants and beta-blockers are used in treatment. These approaches have demonstrated effectiveness in many cases though they treat the symptoms and not the underlying causes (5, 6).
With such a high demand being placed on the health services, such as these traditional forms of care, it can be difficult for many to receive treatment (7, 8). It may therefore be important and helpful to consider innovative approaches that could support the demand for mental health services (9). Recently, it has been suggested that osteopathic interventions could be one such approach to support mental health services (10, 11).

Osteopathy is an approach to health care that uses manual techniques to diagnose and treat patients (12). Osteopathy is an Allied Health Profession in England and osteopaths in the UK are regulated by statute (13). An osteopathic approach is patient-centred and focused on the patient’s health rather than disease-centred. The practices are evidence-informed and scientific rigour forms an important part of treating patients and managing cases (14). Osteopaths use manual contact to identify and evaluate movement in all structural and functional aspects of the patient, identifying alterations of function and movement that impede health and addressing these. Osteopaths use a variety of techniques to manipulate joints, muscles, and tissue. All of the techniques used have an effect on the interplay between the nervous and musculoskeletal systems (15-17). Specific techniques include myofascial release, lymphatic drainage, high-velocity, low amplitude (HVLA), articulatory techniques, and muscle energy techniques.

The rationale for linking mental health with physiological mechanisms comes as previous studies have examined how osteopathy may influence psychophysiological factors. A number of these have examined the influence of osteopathic manipulative therapy (OMT) on heart rate variability (HRV), which is considered a potentially important indicator of physical and psychological wellbeing (18, 19). Cerritelli et al. (20) found that two sessions of OMT significantly increased HRV in healthy adults, relative to a sham control group. Similarly, Arienti et al. (21) found that applying a single session of fourth ventricle compression (CV4) significantly increased HRV, compared to a placebo intervention. So,
there seems to be some clear evidence that influencing physiological mechanisms through osteopathy are highly relevant for mental health improvement. Indeed, studies have found that osteopathic interventions have led to improvements in mental health outcomes such as anxiety (22), depression (23), and stress (24). However, few studies have sought to examine the effects of osteopathy on both physiological and psychological outcomes.

This feasibility protocol will, therefore, explore both the potential psychological and psychophysiological changes that occur after osteopathic treatment, in a small group of individuals who suffer from mild to moderate forms of anxiety, stress, and depression.

6.2 Choice of comparators

This study will be comparing four osteopathic interventions: (1) articulation and high-velocity thrust (HVT) techniques, (2) soft-tissue massage, (3) craniosacral techniques, and (4) a combination of all three techniques.

The choice of techniques in this study has been informed by a systematic review and meta-analysis by the authors into the impact of osteopathic interventions on psychophysiological factors\(^1\). This review included randomised controlled trials of manual interventions and their effects on factors including mental health outcomes and physiological indicators such as HRV and interoception. Articulation techniques were found to improve psychological outcomes (25, 26), as well as autonomic nervous system indicators such as heart rate variability (HRV) and interoception (27). Similarly, interventions utilising HVT improved interoceptive accuracy and led to greater activation of brain areas associated with the interoceptive pathways (28). The studies that suggested articulation could improve psychological outcomes were conducted with chronic pain patients and the study on HVT with healthy participants. It will, therefore, be useful to understand whether articulation

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\(^1\) This systematic review has been preregistered on OSF and the protocol is available via this link: [https://osf.io/jripx/?view_only=63f1a916b76c4b95b4233d3cd8128f2d](https://osf.io/jripx/?view_only=63f1a916b76c4b95b4233d3cd8128f2d)
techniques and HVT could have positive psychological effects in the absence of pain and in
the presence of mild mental health symptoms.

Next, soft-tissue massage techniques were chosen. Studies show that this approach
has several positive psychological impacts for individuals with chronic pain (23) and pain-
free patients who have mental health diagnoses (22, 29). Massage therapy has also been
shown to have a preventative effect for general stress and wellbeing (24). Lastly, massage
techniques have been shown to induce autonomic relaxation in healthy participants by
increasing HRV (30).

The third intervention will utilise craniosacral techniques. Three studies suggested
that this approach induces autonomic relaxation by increasing HRV. One of these studies was
conducted with patients with chronic pain (31) and two were carried out with healthy
participants (21, 32). It will therefore be useful to see whether any potential autonomic
changes from craniosacral techniques translate to psychological benefits. It will also be useful
to examine the potential utility of these techniques with participants who have mild mental
health symptoms.

The body areas that each intervention will focus on have also been informed by the
aforementioned literature. The interventions will operate on a standardised protocol whereby
body areas will be worked on in order by the practitioner. The body areas focussed on and the
order they will be worked on will be described further in the specific procedures of each
intervention.

7. Objectives

This study aims to investigate the feasibility and acceptability of four osteopathic
interventions for adults with mild to moderate mental health symptomatology. A secondary
aim is to evaluate the influence of these four interventions on physiological factors including
HRV and interoception. The study will aim to evaluate their effectiveness in improving
psychological outcomes including depression, stress, anxiety, negative affect, and psychological flexibility. It is first hypothesised that the interventions will be feasible and acceptable to participants. It is also hypothesised that the interventions will induce psychophysiological relaxation by significantly increasing HRV and improving interoceptive accuracy. No specific predictions are made about blood pressure as data on this is only being collected to check that we are within safe blood pressure bounds, i.e., for participant safety. A final hypothesis is that the four interventions will lead to similar improvements in depression, anxiety, stress, and negative affect.

8. Trial design

This is a feasibility study, which will utilise an explanatory sequential mixed-methods approach. In this approach the quantitative aspect forms the first part of the study, followed by a qualitative aspect to help provide further explanation and depth (33). For the quantitative aspect, the study will utilise a parallel, randomised design with an equal proportion of participants allocated to each of the four conditions. The qualitative aspect will be completed by interviewing the participants of the intervention and the practitioner delivering them.

Methods: Participants, interventions, and outcomes.

9. Study setting

The study will take place at Swansea University in South Wales, UK with participants being recruited from both the student population at the university and the general public. The interventions will only take place in one location and country: Wales, UK. The study began on December 20th, 2022, and the study will be completed by August 1st, 2023.

10. Eligibility Criteria

Eligibility criteria will include being over 18 years of age, experiencing mild to moderate symptoms of depression, stress, or anxiety, and being able to read, write and speak English. Prospective participants will be excluded if they are experiencing acute or chronic
pain, and/or if they have no psychological symptoms or more severe mental health issues.
The rationale for excluding participants with pain is that it may present a confounding variable. That is, if the osteopathic intervention alleviates any pain the participants are experiencing, this may lead to improvements in psychological symptoms. It would therefore not be clear whether osteopathy has a more direct influence on mental health outcomes.
Screening for mild to moderate psychological symptoms will be conducted using the Depression, Anxiety, Stress Scale (DASS).

11.1 Interventions

Participants will receive one of four interventions based on osteopathic techniques.
All four interventions will consist of a single session lasting approximately 30 minutes. The interventions are being delivered by two male osteopaths, one with 17 years of practice experience and one with 3 years of practice experience. The interventions will be as follows: (1) articulation and high-velocity thrust (HVT) techniques, (2) soft-tissue massage, (3) craniosacral techniques, and (4) a combination of all three techniques. A summary of the intervention protocols can be found in Table 1.

Table 1.
Summary of the four intervention protocols and procedures.

<table>
<thead>
<tr>
<th>For all</th>
<th>30-minute appointment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clinical findings, intervention, consent, and adverse events (separate form to use if they do) recorded in participant individual form</td>
</tr>
<tr>
<td>Articulation / HVT group</td>
<td>Observation + AROM (standing or sitting) + clinical examination for SD (sitting, prone, or supine)</td>
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<tr>
<td></td>
<td>2. Techniques:</td>
</tr>
<tr>
<td></td>
<td>a. SD found: HVT to the area unless contraindicated (info on BP/HUm)</td>
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<tr>
<td></td>
<td>b. No SD found:</td>
</tr>
<tr>
<td></td>
<td>i. HVT TSp and ribs</td>
</tr>
<tr>
<td></td>
<td>ii. Articulation of hips in extension</td>
</tr>
<tr>
<td>Soft tissue group</td>
<td>Full body, slow and superficial</td>
</tr>
<tr>
<td></td>
<td>1. Prone:</td>
</tr>
<tr>
<td></td>
<td>a. upper / mid / lower back</td>
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<tr>
<td>DURATION</td>
<td>1. 10 min</td>
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<td></td>
<td>2. 20 min</td>
</tr>
<tr>
<td></td>
<td>1. 15 min</td>
</tr>
</tbody>
</table>
11.1.1 Articulation and high-velocity techniques

The articulation and high-velocity (AHVT) intervention will begin with an examination of the participant to search for somatic dysfunction (34). The AHVT intervention will primarily be targeting all areas of the participant’s spine. That is, the cervical, thoracic, and lumbar areas, and also the sacroiliac joints. The practitioner will first observe the participant while standing, then will observe active range of movements with the participant in standing and/or sitting positions. Then the practitioner will continue their examination searching first by light and then deeper palpation for signs associated with somatic dysfunction with the participant sitting down or lying prone or supine. This segment of the intervention will be allocated approximately 10 minutes.
If areas of the spine are found to have somatic dysfunction, then AHVT techniques will be applied to these areas. If no areas of somatic dysfunction are identified in the aforementioned spinal areas, then the practitioner will first focus on applying AHVT techniques to the thoracic spine and rib cage areas, followed by articulation techniques such as hip extension. The application of techniques will be allocated approximately 20 minutes.

### 11.1.2 Soft-tissue massage techniques

The soft-tissue massage (STM) intervention will be a full-body massage. The participant will first be in the prone position and the practitioner will massage the upper, middle, and lower areas of the back, the upper buttocks, then the hamstrings and calves. This will be approximately 15 minutes. The participant will then move into the supine position where they will receive massage on their neck, shoulders, pectoral muscles, arms, quadriceps, and feet. This will also be allocated approximately 15 minutes. The literature suggests that slower techniques such as Swedish massage demonstrate effectiveness (24, 29). There is also evidence that focusing on the upper layers of the skin has psychological benefits (23). These techniques will therefore be employed here.

### 11.1.3 Craniosacral techniques

This intervention will utilise craniosacral techniques (CST). This approach targets the cranial muscles and muscles around the central nervous system (35). The CST intervention will begin with an examination for somatic dysfunction such as stiffness, asymmetry, or tenderness. The body areas focussed on will be the soft tissue around the head and sacrum areas which are body areas commonly associated with CST. If areas of dysfunction are identified, then the practitioner will perform myofascial release. If no areas of dysfunction in these areas are identified, the practitioner will first focus on the sacral region and then move on to other areas associated with CST. For sacral and cranial areas, approximately 10 minutes will be allocated each for 20 minutes total. The intervention will conclude with fourth
ventricle compression (CV4). This technique is performed on the occipital bone. CV4 will be
allocated approximately 10 minutes of the intervention.

11.1.4 Combination of techniques

This intervention will be a combination of all three techniques used in the other interventions
(COMBO). The intervention will begin with an examination of the participant and checking
active and passive range of movement. This examination will be allocated approximately 9
minutes. Using a combination of treatments, the intervention will consist of: (1) high-velocity
techniques applied to the thoracic spine (approximately 7 minutes), (2) soft-tissue massage to
the upper and lower back of the participant in prone (approximately 7 minutes), (3) CV4 and
suboccipital muscles release (approximately 7 minutes). This intervention will therefore last
approximately 30 minutes.

11.2 Modifications

In the interest of participant’s safety, certain modifications may be made to the interventions
if participants have body areas that are tender or if they present undiagnosed high blood
pressure (HBP). This is mostly relevant to the AVHT intervention and COMBO intervention
which will have techniques that are of higher force. If a participant in the AVHT or COMBO
interventions presents with HBP, neck pain, or headaches during the intervention then the
practitioner will not work on the cervical spine area and focus on the other spinal regions in
the protocol. The justification is that HVT techniques may increase the risk of arterial
damage in individuals with HBP (36, 37).

11.3 Adherence

As the intervention only consists of one session, adherence is not necessarily applicable.
Instead, a record will be kept of any participants who asked to end the intervention session
early.

11.4 Concomitant care
Participants will be asked at pre-intervention if they are receiving any drug treatment for mental health (e.g., antidepressants), or psychotherapy (e.g., cognitive behavioural therapy). Participants will not be excluded on this basis, but these will be factored into the main statistical analysis as covariates.

12. Outcomes

The primary outcomes are the feasibility and acceptability outcomes (12.1 and 12.2), whilst the secondary outcomes are the psychological outcome measures (12.3.1 to 12.3.5) and the psychophysiological measures (12.4.1 to 12.4.3).

12.1 Feasibility

The feasibility of the recruitment process will be determined by the number of people who respond to the advertisements and the number of people who are eligible/ineligible following the screening process. Specifically, recruitment will be considered feasible if more than 100 people respond and if at least half of the responders are eligible following screening. The feasibility of the measurement tools will first include whether participants have enough time to complete all measures. The feasibility of the questionnaires will also be assessed by any missing data. Additionally, the feasibility of the physiological measurements will be informed by the time taken to set up the equipment. The measures will therefore be considered feasible if they can all be completed in the allotted time (approximately 40 minutes).

12.2 Acceptability

The acceptability of the study will be largely informed by the qualitative interview following the intervention.

Participants will be interviewed about their experience of the intervention via telephone approximately one week after they have completed the study. The interviews will be semi-structured and follow a pre-defined schedule (see Table 2). The interview will be centred
around the acceptability of the intervention, but also aspects of the study. To this end, the interview will ask questions about motivations for taking part and expectations, how informed they felt before taking part, their experience of completing the questionnaires and having physiological measures taken, and their experience of the intervention itself. Some questions will also ask participants how they have felt since the intervention. Participants will then be given a chance to provide any other feedback or thoughts on taking part in the study. The audio from the interviews will be recorded and then transcribed.

Analysis of the data will be conducted using reflexive thematic analysis (38). This involves initially familiarising oneself with the transcripts and then coding the data. Codes are then collated into themes. From here, themes are refined and categorised into main themes, midlevel themes, and subthemes. Themes will then be discussed in terms of their strength. That is an indication will be provided of whether themes were common across many participants’ accounts, or only mentioned by a few. It is hoped that by employing qualitative methods, a richer account of the acceptability of the study and intervention to participants can be obtained.

The practitioners will also be interviewed about their experience of delivering the intervention. This interview will also be thematically analysed, and the resulting themes explored.

**Table 2.**

<table>
<thead>
<tr>
<th>Interview schedule for qualitative interviews.</th>
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<tbody>
<tr>
<td><strong>Information and consent</strong></td>
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<td></td>
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<tr>
<td><strong>Motivations for participating</strong></td>
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<td></td>
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<tr>
<td>Outcome measures-</td>
</tr>
<tr>
<td>questionnaires</td>
</tr>
<tr>
<td>Outcome measures-</td>
</tr>
<tr>
<td>physiological</td>
</tr>
<tr>
<td>Intervention</td>
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<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Closing points</td>
</tr>
</tbody>
</table>

Additionally, any adverse events occurring during the study will be logged using the Adverse Events Report Form (AERF; this can be found in Supplemental material 2).

### 12.3 Psychological outcomes

These measures are intended to provide some initial data on the potential utility of the intervention for outcomes such as depression, anxiety and stress, psychological flexibility, and interoceptive awareness. They will be collected during pre- and post-intervention and any changes will be analysed.

#### 12.3.1 Mental health

**Depression, Anxiety, and Stress Scale (DASS-21)**

The DASS (39) is a self-report measure made up of 21 items with three subscales that measure depression, anxiety, and stress. The DASS will also be used as a screening tool to
identify eligible participants in terms of the severity of mental health symptoms. Examples of items include “I couldn’t seem to experience any positive feeling at all” for the depression scale, “I felt I was close to panic” for the anxiety scale, and “I found myself getting agitated” for the stress scale. These are then rated on a four-point Likert scale ranging from 0 (never) to 3 (almost always). Higher scores indicate higher levels of depression, anxiety, and stress. The subscales have good internal reliability as measured by Cronbach’s alpha coefficients (α), which are 0.88 for depression, 0.82 for anxiety, and 0.90 for stress, as well as 0.93 for the total score (40).

**International Positive and Negative Affect Schedule- Short-Form (PANAS-SF)**

The PANAS-SF (41) is a short-form version of the PANAS and uses 10 items to measure two subscales of positive and negative affect (PA and NA). Participants are asked to what extent they have felt certain states or emotions, such as “inspired” for the PA scale and “upset” for the NA scale. These are then rated on a five-point Likert scale ranging from 1 (very slightly or not at all) to 5 (extremely). Higher scores indicate higher levels of PA and NA. Both the PA and NA subscales have good internal reliability with both having a Cronbach’s α of 0.84 (41).

**12.3.2 Psychological flexibility**

**Acceptance and Action Questionnaire-II (AAQ-II)**

The AAQ-II (42) is a self-report measure made up of 7 items that measures psychological inflexibility or as it is also referred to, experiential avoidance. Items include a list of statements such as “I’m afraid of my feelings” and “worries get in the way of my success”. These items are then rated on a seven-point Likert scale from 1 (never true) to 7 (always true). Scores are then totalled with higher scores indicating greater levels of psychological inflexibility and experiential avoidance. The AAQ-II has good internal reliability with a Cronbach’s α of 0.84 (42).
Self as Context Scale (SACS)

The SACS (43) uses 10 items to measure self-as-context, one of the acceptance components of psychological flexibility. Self-as-context can be described as a transcendent sense of self, where the individual is able to distance their “noticing self” from internal thoughts and feelings. The SACS has two subscales, (1) centering e.g., “when I am upset, I am able to find a place of calm within myself”, and (2) transcending e.g., “As I look back upon my life so far, I have a sense that part of me has been there for all of it”. Items are then rated on a seven-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). Higher scores on the subscales indicate higher levels of centering, and transcending and a higher total score indicates greater levels of self-as-context. The SACS has good internal reliability with Cronbach’s $\alpha$ of 0.81 for centering, 0.78 for transcending, and 0.81 for overall SACS score (43).

12.3.3 Interoceptive awareness

Multidimensional Assessment of Interoceptive Awareness Version 2 (MAIA-2)

The MAIA-2 (44) is a 37-item self-report measure of interoceptive awareness. The MAIA-2 uses eight subscales which are: (1) noticing e.g., “when I am tense, I notice where the tension is located in my body”, (2) not-distracting e.g., “I distract myself from sensations of discomfort”, (3) not-worrying e.g., “when I feel physical pain, I become upset”, (4) attention regulation e.g., “I can pay attention to my breath without being distracted by things happening around me”, (5) emotional awareness e.g., “I notice how my body changes when I am angry”, (6) self-regulation e.g., “when I feel overwhelmed I can find a calm place inside”, (7) body listening e.g., “I listen for information from my body about my emotional state, and (8) trusting e.g., “I trust my body sensations”. The items are rated on a six-point Likert scale ranging from 0 (never) to 5 (always). The scales have good internal reliability with the Cronbach’s alpha coefficients for the scales being: 0.64 for noticing, 0.74 for not-distracting,
0.67 for not-worrying, 0.83 for attention regulation, 0.79 for emotional awareness, 0.79 for self-regulation, 0.80 for body listening, and 0.83 for trust (44).

12.4 Physiological outcomes

These measures will provide initial data on how the intervention impacts psychophysiological factors. These measures will be collected during pre- and post-intervention and any changes analysed. The physiological measures are all being conducted in the same environment.

12.4.1 Heart rate variability (HRV)

HRV will be measured using a medical-grade Holter electrocardiogram (ECG) monitor. Measurements will be taken at two time points, pre-and post-intervention. Participants will lie in a supine position while the ECG monitor records for at least 5 minutes. Participants will be asked in advance to refrain from consuming any caffeine, alcohol, or nicotine on the day of the study, to minimise interference with the ECG. A time-domain signal measure will be calculated using the root mean square of successive interval differences (RMSSD). Frequency-domain measurements will also be calculated by using low-frequency power, high-frequency power, and low-frequency to high-frequency ratio (LF/HF). This measure will be analysed in conjunction with the recent literature that suggest it is a measure of primarily the parasympathetic system (45).

12.4.2 Interoceptive accuracy (IAc)

Participants will perform a heartbeat detection task as a measure of IAc. This is conducted in the form of the heartbeat perception task which is performed according to the Mental Tracking Method (46) using intervals of 30, 35, 40, and 45s that are separated by 30s resting periods. During each trial R–R intervals are recorded, and participants are asked to silently count their heartbeats without the use of an exteroceptive aid (such as taking one’s pulse). At the end of each period, participants verbally report the number of counted heartbeats. The participants will not be informed about the length of the counting phases nor the quality of
their performance. Interoceptive sensibility will also be measured through participants’ subjective assessments about how accurately they perceived heartbeats (47). These measures will be completed pre- and post-intervention.

12.4.3 Blood pressure (BP)

BP will be measured at pre- and post-intervention. This will be carried out in line with the National Institute for Health and Care Excellence (NICE) recommendations. That is, BP will be collected in a room that is quiet, relaxed, and temperate, whilst the participant will be quiet and seated, and their arm outstretched and supported, using an appropriate cuff size for the person’s arm (48). This outstretching of the arm will allow the practitioner to assess any undiagnosed HBP. If the participant has HBP it can make some of the osteopathic techniques less safe (36, 37), so it is important to establish this. HBP will be determined according to the NICE recommendation of BP results that are 140/90 mmHg and over (48). In addition to participant safety, measuring BP will provide data on any impact the intervention might have on this physiological indicator.

12.5 Additional outcomes

Demographic information will also be collected from participants relating to their gender, age, and ethnic background. Although participants will have been screened for chronic pain, they will be asked whether they are currently or have recently been experiencing any neck pain or headaches. This is to inform the clinician about any problematic body areas, which may therefore be avoided in the intervention. The participants should be presenting as pain-free due to the initial screening process, but this is still a necessary safety measure. Participants will be excluded from the analysis if they present with neck pain or headaches.

Participants will also be asked whether they are currently receiving any mental health treatment. They will be asked whether they are currently taking any antidepressants or other related prescribed medication for mental health issues. Participants will also be asked
whether they have recently attended or are currently attending any form of talking therapy or other psychotherapy. Participants’ prescription medication or psychotherapy status will not exclude them from the study. However, this will again be entered as a covariate if several participants report that they are receiving these psychological treatments.

Lastly will be the noting of any adverse events that occur during the intervention or study period. These will be filled out by the practitioner using the AERF and collected by the researcher if occurring during the intervention. If participants contact the researcher after the intervention regarding an adverse event, then this will be logged by the researcher.

13. Participant timeline

See Table 3 for the participant timeline.

**Table 3.** Participant timeline

<table>
<thead>
<tr>
<th>Activity/Assessment</th>
<th>Approx. time to complete</th>
<th>T₀</th>
<th>T₁</th>
<th>T₂</th>
<th>T₃</th>
<th>F₁</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informed consent</td>
<td>5 mins</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screening with DASS</td>
<td>5 mins</td>
<td></td>
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<td></td>
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<tr>
<td>Randomisation</td>
<td>15 mins</td>
<td></td>
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<td></td>
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<tr>
<td>Baseline assessment-questionnaires</td>
<td>15 mins</td>
<td></td>
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<tr>
<td>Baseline assessment-physiological</td>
<td>15 mins</td>
<td></td>
<td></td>
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<tr>
<td>Intervention</td>
<td>30 mins</td>
<td></td>
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<tr>
<td>Post-intervention questionnaires</td>
<td>15 mins</td>
<td></td>
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<tr>
<td>Post-intervention physiological</td>
<td>15 mins</td>
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<tr>
<td>Telephone interview</td>
<td>30 mins</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Approx. time to complete</th>
<th>Pre-study Screening/consent</th>
<th>Pre-study randomisation</th>
<th>Pre-intervention</th>
<th>Post-intervention tests</th>
<th>Follow-up 1-week</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 mins</td>
<td>X</td>
<td></td>
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<td></td>
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<tr>
<td>5 mins</td>
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<td>15 mins</td>
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</tbody>
</table>

**Abbreviations:** T: Timepoint; F: Follow-up; DASS: Depression Anxiety Stress Scale.

14. Sample Size
The study will aim to recruit 32 participants. This number of participants is generally deemed sufficient for feasibility studies (49) and would represent approximately 10% of the sample size required in a full trial (50). This sample size also falls within what is practical given the available resources.

15. Recruitment

Recruitment at the university is being conducted by advertising in communal spaces with posters. Additionally, social media will be used for recruitment by reaching out to mental health support groups and sharing an advertisement for the study on various social networks (note: this recruitment work has begun). Participants will contact the research team if they are interested in taking part. They will then be given an information sheet to read and a consent form to sign. Following this they will complete the DASS to complete to determine their eligibility regarding mental health symptoms. The cut-off scores for mild to moderate will be defined as follows: depression = 10-20, anxiety = 8-14, and stress = 15-25 (51). If eligible they will be invited to take part in the intervention. If they display severe mental health symptoms, they will not be invited to take part further and signposted to the relevant mental health services and charities.

Methods: Assignment of interventions

16. Allocation

16.1 Sequence generation

The 32 participants will be randomly assigned to one of the four conditions using a computerised random number generator. Permutated block randomisation will be used to ensure that equal numbers of participants are in each condition. The block sizes will not be disclosed to help ensure concealment and prevent any potential prediction of group allocation. This will be conducted by the principal investigator (PI) of the study DJE, whilst the outcome assessor JH-B is blinded to this randomisation process.
16.2 Concealment mechanism

Allocation concealment will be ensured using sequentially numbered, sealed opaque envelopes which contain the group assignment. The PI will carry out the allocation concealment, and ensure that the outcome assessor is blinded to the intervention allocation.

16.3 Implementation

All participants who provide informed consent and who meet the eligibility criteria will be randomised into a study condition (as described in section 16.1). The randomiser DJE will not be directly involved in the recruitment or data collection, and instead, the outcome assessor will conduct the recruitment. The list of random numbers that correspond to group allocation will not be revealed to the researcher (JH-B) involved in data collection or recruitment. The sealed envelopes will contain a randomisation number and corresponding intervention identity code for the allocation of participants into the intervention groups. The osteopathic practitioner will then be able to open the envelope and determine which intervention is to be delivered on the day the study is conducted.

17.1 Blinding (masking)

The outcome assessor will be blind to the participant’s group allocation. After pre-intervention psychometric and psychophysiological measures (see sections 12.3 and 12.4 respectively) have been completed, the outcome assessor will leave the room (to ensure blinding) and the intervention will begin, conducted by the osteopath. Participants will not be blinded to study intervention, as the osteopathic practitioner will need to explain study and intervention procedures, in line with the osteopathic practice standards and ethical consent (14). The practitioner will not be blinded to the intervention type (as they need to know what intervention to deliver) but will be blinded to the study outcomes. The outcome assessor will also be conducting the data analysis, and the random numbers corresponding to each group will only be revealed when this analysis has been completed. To ensure participants do not
disclose the condition they were allocated to, they will be asked not to communicate directly
to the outcome assessor about the intervention they received. The study will therefore be
single-blinded, where the outcome assessor is blind to intervention allocation, and the
osteopathic practitioner will not be blind (hence single-blind).

17.2 Emergency unblinding
As the practitioner is not blinded, no emergency unblinding procedures are deemed
necessary.

Methods: Data management and analysis

18. Data management
All data will be entered electronically at the university where the data is being collected and
kept in a password-protected folder, which only the outcome assessor will have access to for
the duration of the study. The electronic data will be kept confidential, and participants’
names will not be linked to their datasets. For the longer term, electronic datasets will be kept
indefinitely in the interest of transparency to fulfil any requests for the original data and
maintained on the Open Science Framework (OSF).

19. Statistical Methods

19.1 Outcomes
Statistical analysis will be conducted using IBM SPSS (v. 27). Means and standard deviations
will be reported for demographic data that includes gender, age, and ethnicity. For the main
analysis, data will first be examined for normality using the Shapiro-Wilk test. If data is
skewed, logarithmic transformation will be used, otherwise, analysis will continue without
any transformation. HRV data will be pre-processed, and inspected for any potential artifacts,
and these will be removed if identified. RMSSD will be calculated on the pre-processed
artifact removed data using Kubios version 3.5\(^2\) via Matlab version R2021a. Interceptive

\(^2\) [https://www.kubios.com/](https://www.kubios.com/)
accuracy (IAc) will then be calculated using the formula: 

\[ IAc = \frac{1}{4} \sum \left[ 1 - \left| \frac{\text{recorded heartbeats} - \text{counted heartbeats}}{\text{recorded heartbeats}} \right| \right] \]

The psychometrics will be totalled according to the relevant questionnaire instructions and subscales.

The main analysis will comprise of seven separate mixed design two (pre- and post-intervention) by four (AVHT, STM, CST, combination) analysis of covariance (ANCOVA) models. This will comprise of five separate ANCOVAs for the five psychometrics (DASS, PANAS-SF, AAQ, SACS, MAIA) and another two ANCOVAs for the physiological measures of IAc and HRV (as measured by RMSSD and LF/HF ratio). Covariates will consist of (1) whether participants are currently receiving psychotherapy (yes or no) and (2) whether participants are receiving pharmacological treatment (yes or no). Significant models will be examined further using post hoc Bonferroni tests.

19.2 Additional Analyses

Exploratory correlational analyses will also be conducted to examine relationships between changes from pre- to post-intervention on the various measures (e.g., the relationship between change from pre-post HRV RMSSD and pre-post DASS scores).

19.3 Analysis of population and missing data

The study will operate on an intention-to-treat basis. All participants randomised and with pre-intervention data will be included in the final analysis. Any participants with missing data will be included in the analysis using the multiple imputation feature of SPSS.

Methods: Monitoring

20. Data monitoring

As this study is taking place over a short duration as a feasibility study and not a full RCT, no formal committee for data monitoring is required.

21. Harms

---

Please see: Interventions section 11.1 for full details of these interventions.
The osteopathic practitioner will inform the participants about the general potential common adverse effects of osteopathy namely some stiffness and soreness in the days following the intervention, and rare adverse events including tissue damage (52), in line with informed consent processes. The osteopathic practitioner will record any adverse effects on the day the intervention is received (that occur during or immediately after the intervention) in the AERF (see Supplemental material 2). Participants will also be advised to contact the PI DJE by telephone if they have any concerns or adverse events following the intervention in subsequent days after the intervention was received. If such events are reported, these will again be reported by DJE in the AERF. Any adverse events or harms that are ranked highly on severity will be reported to the ethical committee. This includes any adverse events that for example require hospitalization.

22. Auditing

As the study is taking place over a short duration and only at one site, no formal auditing processes are deemed necessary, though PI will have regular team meetings to ensure the study is following the research protocol at all times.

Methods: Patient and public involvement statement

Key stakeholders were consulted and involved at a very early stage of the research process. The Patient Experience and Evaluation in Research (PEER)^4 group in the College of Human and Health Sciences at Swansea University were consulted. This group represented members of the public, students, and staff members, several of whom reported that they had experienced depression, anxiety, or stress at some point in their lives and emphasised the need for innovative approaches to the delivery of mental health support. The feasibility

design was explained to them, and they gave positive feedback about the nature of the preliminary research plan.

**Ethics and dissemination**

**23. Research ethics approval**

The protocol for this feasibility study has received ethical approval from the Department of Psychology Ethics Committee at Swansea University, ethical review reference number: 2022-5603-4810.

**24. Protocol amendments**

Any deviations from the protocol that could impact the conduct or bias of the study will be clearly outlined and justified in the final written report. Version control of the protocol using identifiers and dates, along with a list of amendments will be clearly listed. This will enable tracking of the history of amendments and identification of the most recent protocol version.

**25. Consent**

Participants will scan a QR code on recruitment posters or click a link via email/social media adverts that will take them to the study’s information sheet. The information sheet emphasises that participation is voluntary and that they can withdraw from the study at any stage, without needing to provide a reason. If they have any questions or concerns at this stage, they are encouraged on the information sheet to contact the research team. If they are willing to proceed, they will complete an online consent form (see Supplemental material 3).

**26. Ancillary research**

The data collected in this study will not be used for any other ancillary research.

**27. Confidentiality**

Participants will be assigned a coded ID number to maintain confidentiality. Any records of personal identifiers such as informed consent forms will be stored separately from data with
ID numbers. To limit data access to the minimum number of individuals, only the researcher JHB will have access to the data for analysis.

28. Declaration of interests

The individual authors have no direct conflicts of interest to declare.

29. Access to data

Only the researcher JHB will have access to the dataset during the study period. Upon completion, the collected data will be deidentified and made available on the OSF. Similarly, the SPSS statistical syntax code used will be made available on OSF.

30. Ancillary and post-trial care

Participants will be fully debriefed once they have completed the study. The contact details of the research team will be provided should participants have any concerns. As the participants will be presenting with mild to moderate mental health symptoms, the debrief form will encourage participants to seek support services such as mental health charities or their GP if their psychological condition deteriorates at any time.

31. Dissemination policy

31.1 Trial results

Following the completion of the study, it is anticipated to take around 2-3 months to compile the final results ready for publication in an appropriate peer-reviewed journal. The study’s results may also be used as part of presentations at any relevant conferences.

31.2 Authorship

The authors of this protocol will also be the authors of the final report. All authors have made substantive contributions to the design of the study. Additionally, all authors will have made substantive contributions to the interpretation of the data collected and the writing of the final report.

31.3 Reproducible research
This protocol will be available to researchers via open-access publication. The dataset collected will be deidentified and made available on OSF. Similarly, the statistical syntax code used will be made available on OSF. These will be made available no later than 1 year upon completion of data collection.

Acknowledgements

We would like to thank Stephen Hartshorn and James Bray for their contributions to delivering the osteopathic interventions.

Contributorship statement

**JHB wrote the first draft, then assisted with subsequently revising additional drafts.**

JHB wrote the first draft of this paper, then assisted with subsequently revising additional drafts. JHB also made substantive contributions to the concept, design, and writing of this study. JRD assisted with revising additional drafts of this paper, and also made substantive contributions to the concept, design, and writing of this study. DE was the principal investigator on the grant (Osteopathic Foundation) that funded this work. DJE therefore made substantial contributions to the design, concept, and writing of this study.

Competing interests

There are no competing interests. This project is funded by the Osteopathic Foundation (OF). The OF has no direct input into any aspects of this study. The individual authors have no direct conflicts of interest to declare.

Funding

This research has been funded by The Osteopathic Foundation, grant award number: URNLG010.

References


**SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents**

<table>
<thead>
<tr>
<th>Section/item</th>
<th>Item No</th>
<th>Description</th>
<th>Addressed on page number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative information</td>
<td></td>
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</tr>
<tr>
<td>Title</td>
<td>1</td>
<td>Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym</td>
<td>Page 3, Section 1.</td>
</tr>
<tr>
<td>Trial registration</td>
<td>2a</td>
<td>Trial identifier and registry name. If not yet registered, name of intended registry</td>
<td>Page 3, Section 2.</td>
</tr>
<tr>
<td></td>
<td>2b</td>
<td>All items from the World Health Organization Trial Registration Data Set</td>
<td>N/A</td>
</tr>
<tr>
<td>Protocol version</td>
<td>3</td>
<td>Date and version identifier</td>
<td>Page 3, Section 3.</td>
</tr>
<tr>
<td>Funding</td>
<td>4</td>
<td>Sources and types of financial, material, and other support</td>
<td>Page 3, Section 4.</td>
</tr>
<tr>
<td>Roles and responsibilities</td>
<td>5a</td>
<td>Names, affiliations, and roles of protocol contributors</td>
<td>Pages 3-4, Section 5.1</td>
</tr>
<tr>
<td></td>
<td>5b</td>
<td>Name and contact information for the trial sponsor</td>
<td>Page 4, Section 5.2</td>
</tr>
<tr>
<td></td>
<td>5c</td>
<td>Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities</td>
<td>Page 4, Section 5.3</td>
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<tr>
<td>Section</td>
<td>Item</td>
<td>Description</td>
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<tr>
<td>5d</td>
<td></td>
<td>Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Introduction**

**Background and rationale**

6a Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention | Pages 4-5, Section 6.1 |

6b Explanation for choice of comparators | Pages 5-7, Section 6.2 |

**Objectives**

7 Specific objectives or hypotheses | Page 7, Section 7 |

**Trial design**

8 Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory) | Page 7, Section 8 |

**Methods: Participants, interventions, and outcomes**

**Study setting**

9 Description of study settings (eg, community clinic, academic hospital) and list of countries where data will be collected. Reference to where list of study sites can be obtained | Pages 7-8, Section 9 |

**Eligibility criteria**

10 Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists) | Page 8, Section 10 |

**Interventions**

11a Interventions for each group with sufficient detail to allow replication, including how and when they will be administered | Pages 8-11, Section 11.1 |

11b Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease) | Page 11, Section 11.2 |

11c Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests) | Page 11-12, Section 11.3 |
Relevant concomitant care and interventions that are permitted or prohibited during the trial.

Outcomes
Primary, secondary, and other outcomes, including the specific measurement variables (eg, systolic blood pressure), analysis metric (eg, change from baseline, final value, time to event), method of aggregation (eg, median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended.

Participant timeline
Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure).

Sample size
Estimated number of participants needed to achieve study objectives and how it was determined, including clinical and statistical assumptions supporting any sample size calculations.

Recruitment
Strategies for achieving adequate participant enrolment to reach target sample size.

Methods: Assignment of interventions (for controlled trials)

Allocation:

Sequence generation
Method of generating the allocation sequence (eg, computer-generated random numbers), and list of any factors for stratification. To reduce predictability of a random sequence, details of any planned restriction (eg, blocking) should be provided in a separate document that is unavailable to those who enrol participants or assign interventions.

Allocation concealment mechanism
Mechanism of implementing the allocation sequence (eg, central telephone; sequentially numbered, opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned.

Implementation
Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions.

Blinding (masking)
Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome assessors, data analysts), and how.
Methods: Data collection, management, and analysis

Data collection methods
18a Plans for assessment and collection of outcome, baseline, and other trial data, including any related processes to promote data quality (e.g., duplicate measurements, training of assessors) and a description of study instruments (e.g., questionnaires, laboratory tests) along with their reliability and validity, if known. Reference to where data collection forms can be found, if not in the protocol.

18b Plans to promote participant retention and complete follow-up, including list of any outcome data to be collected for participants who discontinue or deviate from intervention protocols. N/A as data only collected pre-post.

Data management
19 Plans for data entry, coding, security, and storage, including any related processes to promote data quality (e.g., double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol.

Statistical methods
20a Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol.

20b Methods for any additional analyses (e.g., subgroup and adjusted analyses)

20c Definition of analysis population relating to protocol non-adherence (e.g., as randomised analysis), and any statistical methods to handle missing data (e.g., multiple imputation).

Methods: Monitoring

Data monitoring
21a Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed.

21b Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial. N/A
<table>
<thead>
<tr>
<th>Section</th>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.</td>
<td>Harms</td>
<td>Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct</td>
</tr>
<tr>
<td>22.</td>
<td>Auditing</td>
<td>Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor</td>
</tr>
<tr>
<td>23.</td>
<td>Ethics and dissemination</td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Research ethics</td>
<td>Plans for seeking research ethics committee/institutional review board (REC/IRB) approval</td>
</tr>
<tr>
<td>24.</td>
<td>Protocol amendments</td>
<td>Plans for communicating important protocol modifications (e.g., changes to eligibility criteria, outcomes, analyses) to relevant parties (e.g., investigators, REC/IRBs, trial participants, trial registries, journals, regulators)</td>
</tr>
<tr>
<td>25.</td>
<td>Consent or assent</td>
<td>Who will obtain informed consent or assent from potential trial participants or authorized surrogates, and how (see Item 32)</td>
</tr>
<tr>
<td>26a</td>
<td>Consent or assent</td>
<td>Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable</td>
</tr>
<tr>
<td>26b</td>
<td>Consent or assent</td>
<td>N/A</td>
</tr>
<tr>
<td>27.</td>
<td>Confidentiality</td>
<td>How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial</td>
</tr>
<tr>
<td>28.</td>
<td>Declaration of interests</td>
<td>Financial and other competing interests for principal investigators for the overall trial and each study site</td>
</tr>
<tr>
<td>29.</td>
<td>Access to data</td>
<td>Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators</td>
</tr>
<tr>
<td>30.</td>
<td>Ancillary and post-trial care</td>
<td>Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation</td>
</tr>
<tr>
<td>31a</td>
<td>Dissemination policy</td>
<td>Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (e.g., via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions</td>
</tr>
</tbody>
</table>
31b Authorship eligibility guidelines and any intended use of professional writers

31c Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code

### Appendices

<table>
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<tr>
<th>Informed consent materials</th>
<th>Model consent form and other related documentation given to participants and authorized surrogates</th>
<th>Supplemental material 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological specimens</td>
<td>Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable</td>
<td>N/A</td>
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</tbody>
</table>

*It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons "Attribution-NonCommercial-NoDerivs 3.0 Unported" license."
Supplemental material 1.  
Adverse events report form

<table>
<thead>
<tr>
<th>Practitioner ID:</th>
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</thead>
<tbody>
<tr>
<td>Date:</td>
<td>Location:</td>
</tr>
<tr>
<td>Description of adverse event:</td>
<td></td>
</tr>
<tr>
<td>Actions taken:</td>
<td></td>
</tr>
<tr>
<td>What? When? By whom? Outcome?</td>
<td></td>
</tr>
<tr>
<td>Further actions needed?</td>
<td></td>
</tr>
</tbody>
</table>
Supplemental material 2.

Consent form

Participant Consent Form

Project title: Measuring psychophysiological outcomes in a therapeutic touch approach.

You must be age 18 or over to complete this study.

Name and Contact details of the principal researchers: Dr Josh Hope-Bell j.b.hope-bell@swansea.ac.uk and Dr Darren Edwards d.j.edwards@swansea.ac.uk.

This study is being conducted by Swansea University, Faculty of Medicine, Health and Life Sciences.

- I (the participant) consent to participate in the study

- I confirm that I have read and understand the information provided in relation to this study.

- I understand that my participation is voluntary. I understand that I am free to withdraw at any time during the study but once I have completed all phases of the study, withdrawal will not be possible because data will be completely anonymised.

- I understand what my role will be in this research, and all my questions have been answered to my satisfaction.

- I have been informed that the information I provide will be safeguarded.

- I am happy for the information I provide to be used (anonymously) in academic papers and other formal research outputs, however my name will not be published so anonymity is ensured.

- I agree to the researchers processing my personal data in accordance with the aims of the study described in the participant information.

- I am age 18 years or above.

If you agree with all statements above, click Yes (I consent)

If you disagree with any of the statements above, click No (I do not consent)